REMARKS

By this amendment claims 16-20, 23-32, and 36-40 have been amended, claims 1-15 have been cancelled, and new claims 41-44 have been added. Thus, claims 16-44 are pending in the present application. The claim amendments and new claims are supported by the specification and claims as originally filed, with no new matter being added. Accordingly, favorable reconsideration of the pending claims is respectfully requested.

Claims 16-20, 23-32, and 36-40 have been amended to replace the abbreviation "ARC" with the terms "antireflective coating" and/or to correct minor typographical errors. The specification has been amended to update the status of the parent application and to correct a typographical error.

1. Election/Restriction

The Office Action indicated that restriction to one of the following invention groups is required under 35 U.S.C. § 121:

I. Claims 1-15, drawn to a coating material; and

II. Claims 16-40, drawn to a semiconductor structure.

During a telephone conversation with the Examiner, Applicant's attorney provisionally elected the invention of Group II, claims 16-40. Applicant hereby affirms the election of the invention of Group II, claims 16-40. Claims 1-15 have been cancelled without prejudice to any subsequent divisional application.

2. Drawings

The Examiner objected to the drawings because Figures 5 and 6 were missing from the present application. Figures 5 and 6 are enclosed herein for inclusion in the present application. Figures 5 and 6 were originally filed with the parent application, Serial No. 08/918,690, filed on August 21, 1997. Accordingly, no new matter is added in the present application by the submission of Figures 5 and 6.

3. Rejections Under 35 U.S.C. § 102

Claims 16 and 18 have been rejected under 35 U.S.C. § 102(b) as being anticipated by U.S. Patent No. 5,066,615 to Brady et al. (hereinafter "*Brady*") for the reasons set forth on page 3 of the Office Action. Applicant respectfully traverses.

Before addressing the claim rejections, Applicant has the following preliminary comments. During the 1980s and early 1990s photolithography had not yet miniaturized integrated circuits (ICs) to the size that they are today. Because of this, larger wavelengths were used in photolithography and consequently antireflective coatings were designed to accommodate the larger wavelengths. When the technology allowed semiconductor manufacturers to miniaturize ICs even further, smaller wavelengths were used in the photolithography process. One consequence of this miniaturization was the defect referred to as "foot poisoning" (*see* page 6, line 18 through page 7, line 21 and Figures 2-4 of the specification). The present invention solves the "foot poisoning" problem by providing an antireflective coating that minimizes reflectivity in the desired wavelength range corresponding to deep ultraviolet (DUV) light.

Brady was cited for disclosing a semiconductor structure comprising a semiconductor substrate, and an antireflective coating over the substrate. The antireflective coating is a metal silicon nitride, with the metal selected from Ti, V, Cr, Zr, Nb, Mo, Hf, Ta, and W.

Independent claim 16 is directed to a semiconductor structure comprising a semiconductor substrate, and an antireflective coating over the semiconductor substrate, with the antireflective coating being composed of a metal silicon nitride ternary compound. Claim 16 has been amended to recite that "the antireflective coating is configured to minimize reflectivity of deep ultraviolet light." Support for this added recitation can be found in the application as filed on page 15, line 24, and page 16, lines 5-8.

There is no teaching or suggestion in *Brady* of an antireflective coating that is "configured to minimize reflectivity of deep ultraviolet light" as recited in present claim 16. Rather, the antireflection layers of *Brady* are disclosed has having minimum reflectivities at wavelengths from about 390 nm to about 600 nm (*see* Figure 6).

Deep ultraviolet light is generally recognized by those skilled in the art to include radiation having wavelengths shorter than those disclosed in *Brady*. For example, the document attached as Exhibit A and entitled "Deep-UV Lithography" shows a table summarizing the properties of light sources used in short wavelength (deep-UV) lithography. The table indicates that such light sources can range in wavelength from 157 nm up to 365 nm (with a bandwidth of 5-10 nm). *Brady* does not disclose such a deep-UV wavelength range, but rather teaches minimizing reflectivity at wavelengths that are longer as indicated above.

Claim 18 is dependent from claim 16 and thus incorporates the recitations thereof. Accordingly, for the above reasons, claims 16 and 18 are not anticipated by *Brady*. Applicant

therefore respectfully requests that the rejection of these claims under 35 U.S.C. § 102(b) be withdrawn.

4. Rejections Under 35 U.S.C. § 103(a)

Claims 17, 19, 26, and 32-36 have been rejected under 35 U.S.C. § 103(a) as being unpatentable over *Brady* in view of U.S. Patent No. 5,116,427 to Fan et al. (hereinafter "*Fan*") for the reasons set forth on pages 4-5 of the Office Action. Applicant respectfully traverses.

Fan teaches a photovoltaic structure that includes an encapsulation/antireflective coating 27 over a metallization/barrier layer 15 on a substrate (*see* Figure 3), or an antireflective coating 27 over a substrate without layer 15 (*see* Figure 2). The barrier layer in *Fan* is disclosed as being TiWN, TiN, WN, TaN, or other refractory nitrides or silicides (col. 2, line 61 through col. 3, line 1). The antireflective coating 27 is disclosed in *Fan* as being preferably silicon nitride (column 5, lines 36-37).

There is no teaching or suggestion in *Fan*, nor in *Brady*, of the specific metal compounds used in the antireflective coating as recited in claims 17 and 19. In particular, there is no teaching or suggestion in the cited references of the titanium tungsten silicon nitride, tungsten aluminum silicon nitride, and titanium aluminum silicon nitride compounds recited in claims 17 and 19.

With regard to independent claim 26, there is no teaching or suggestion in *Fan*, nor in *Brady*, of the antireflective coating as recited therein composed of a metal silicon nitride ternary compound $M_xSi_yN_z$, with M being at least two transition metals composed of M1 and M2. While the Examiner cites *Fan* for teaching that M1 and M2 can be Ti and W, *Fan* only teaches a

nitride compound of these metals (*i.e.*, TiWN) for use in a barrier layer, and not a metal silicon nitride compound as recited in claim 26 for an antireflective coating.

With respect to independent claim 32, there is no teaching or suggestion in *Fan*, nor in *Brady*, of the antireflective coating as recited therein composed of a metal silicide binary compound. In contrast, the antireflective coating 27 of *Fan* is disclosed as being silicon nitride, and the antireflection coating 21 in *Brady* is disclosed as being a metal silicon nitride.

As to claim 36, the metal silicide itself is not used in *Brady* as the antireflection coating as the Examiner appears to assert. Rather, *Brady* teaches that the metal silicide compound such as tungsten silicide is used as the sputtering target in a nitrogen-containing atmosphere to form the metal silicon nitride antireflection coating (col. 2, lines, 5-12). In addition, as discussed previously, the antireflective coating 27 of *Fan* is disclosed as being silicon nitride.

Accordingly, for the foregoing reasons, Applicant submits that claims 17, 19, 26, 32, and 36 would not have been obvious over the cited references. Claims 33-35 depend from claim 32 and thus include the limitations thereof. Therefore, claims 33-35 would also not have been obvious over the cited references for at least the reasons stated hereinabove with respect to claim 32. Applicant therefore respectfully requests that the rejection of claims 17, 19, 26, and 32-36 under 35 U.S.C. § 103(a) be withdrawn.

Claims 20-25, 27-31, and 37-40 have been rejected under 35 U.S.C. § 103(a) as being unpatentable over *Brady* in view of U.S. Patent No. 5,886,391 to Niroomand et al. (hereinafter "*Niroomand*") for the reasons set forth on pages 5-7 of the Office Action. Applicant respectfully traverses.

Niroomand was cited for disclosing a polysilicon layer that is a rough or hemispherical grained layer in an antireflective structure.

Independent claim 29 has been amended to recite that "the antireflective coating is configured to minimize reflectivity of deep ultraviolet light." As discussed previously with respect to claim 16, there is no teaching or suggestion in *Brady* of an antireflective coating that is "configured to minimize reflectivity of deep ultraviolet light" as recited in present claim 29. *Niroomand* also does not teach or suggest such a limitation.

Accordingly, Applicant submits that claim 29 would not have been obvious over the cited references. Claims 30-31 depend from claim 29 and thus include the limitations thereof. Therefore, claims 30-31 would also not have been obvious over the cited references for at least the reasons stated hereinabove with respect to claim 29.

Claims 20-25 depend from claim 16 and thus include the limitations thereof. As discussed above with respect to claim 16, there is no teaching or suggestion in *Brady* of an antireflective coating that is "configured to minimize reflectivity of deep ultraviolet light." *Niroomand* also does not teach or suggest such a limitation. Accordingly, claims 20-25 would not have been obvious over the cited references.

Claims 27-28 depend from claim 26 and thus include the limitations thereof. As discussed above with respect to claim 26, there is no teaching or suggestion in *Brady* of an antireflective coating composed of a metal silicon nitride ternary compound $M_xSi_yN_z$, with M being at least two transition metals composed of M1 and M2. *Niroomand* also does not teach or suggest these claimed features. Accordingly, claims 27-28 would not have been obvious over the cited references.

Claims 37-40 depend from claim 32 and thus include the limitations thereof. As discussed above with respect to claim 32, there is no teaching or suggestion in *Brady* of an antireflective coating composed of a metal silicide binary compound. In contrast, the

antireflection coating in *Brady* is disclosed as being a metal silicon nitride. Likewise, *Niroomand* also does not teach or suggest an antireflective coating composed of a metal silicide binary compound. Rather, *Niroomand* discloses antireflective structures that include layers of polysilicon and silicon nitride. Accordingly, claims 37-40 would not have been obvious over the cited references.

For the above reasons, Applicant respectfully requests that the rejection of claims 20-25, 27-31 and 37-40 under 35 U.S.C. § 103(a) be withdrawn.

5. New Claims

New claims 41-44 include subject matter similar to various original claims and thus present no new matter. Independent claim 41 includes similar subject matter as claim 17, discussed above. Independent claim 42 includes similar subject matter as claim 16, but limits the metal to at least one metal selected from the group of Sc, Co, Al, and Ni. There is no teaching or suggestion in the cited references of an antireflective coating comprising a metal silicon nitride compound, with the metal selected from this group. Independent claim 43 also includes similar subject matter as claim 16, but recites that the antireflective coating has a thickness range from about 25 Angstroms to about 200 Angstroms. Support for this thickness range can be found in claims 6-8 of the application as filed. There is no teaching or suggestion in the cited references of the recited antireflective coating with this thickness range. Claim 44 depends from claim 43 and recites a narrower thickness range.

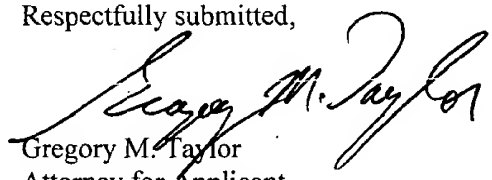
Accordingly, Applicant submits that new claims 41-44 present patentable subject matter and respectfully requests the prompt allowance of these claims.

CONCLUSION

In view of the foregoing, Applicant respectfully requests favorable reconsideration and allowance of the pending claims. In the event the Examiner finds any impediment to the prompt allowance of this application that could be clarified by a telephone interview, the Examiner is respectfully requested to contact the undersigned attorney.

Dated this 23rd day of October 2001.

Respectfully submitted,



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VERSION WITH MARKINGS TO SHOW THE CHANGES MADE

IN THE SPECIFICATION:

The paragraph beginning at page 2, line 2 has been amended as follows:

This is a divisional application of US Patent Application Serial No. 08/918,690, filed August 21, 1997, titled Antireflective Coating Layer and Method of Making, now abandoned, which is incorporated herein by reference.

The paragraph beginning at page 14, line 10 has been amended as follows:

-- An antireflective structure according to the present invention comprises an antireflective layer that resists fouling of the semiconductor structure such as photoresist foot poisoning and that has the ability to [absorbed] absorb light or to scatter light into patterns and intensities that do not substantially affect photoresist material that is exposed by those patterns and intensities. --

IN THE CLAIMS:

Claims 16-20, 23-32, and 36-40 have been amended as follows:

16. (Once Amended) A semiconductor structure comprising:

a semiconductor substrate; and

an [ARC] antireflective coating over the semiconductor substrate, [said ARC] the antireflective coating being composed of a metal silicon nitride ternary compound, wherein the metal is at least one metal selected from the group consisting of Sc, Ti, Zr,

Nb, Ta, Mo, W, Co, Al, and Ni, wherein the antireflective coating is configured to minimize reflectivity of deep ultraviolet light.

17. (Once Amended) The semiconductor structure as defined in Claim 16, wherein the metal silicon nitride ternary compound is selected from the group consisting of titanium tungsten silicon nitride, tungsten aluminum silicon nitride, and titanium aluminum silicon nitride.

18. (Once Amended) The semiconductor structure as defined in Claim 16, wherein [said ARC] the antireflective coating has a thickness range from about 25 Angstroms to about 1,000 Angstroms.

19. (Once Amended) The semiconductor structure as defined in Claim 16, wherein the metal is selected from the group consisting of Ti_rW_{1-r}, W_rAl_{1-r}, [or] and Ti_rAl_{1-r}.

20. (Once Amended) The semiconductor structure as defined in Claim 16, wherein:

[said ARC] the antireflective coating has a film thickness and a grain size; and

the grain size of the [ARC] antireflective coating is less than the film thickness or is amorphous.

23. (Once Amended) The semiconductor structure as defined in Claim 21, wherein [said ARC] the antireflective coating is further composed of hemispherical grained polysilicon.

24. (Once Amended) The semiconductor structure as defined in Claim 16, wherein the [ARC] antireflective coating reflects incident light energy in a reflectivity that is in a range from 0 percent to about 30 percent.

25. (Once Amended) The semiconductor structure as defined in Claim 16, wherein:

the [ARC] antireflective coating is upon a formation that is selected from the group consisting of an isolation trench, a contact corridor, a via, a stacked storage node well, and a wiring trench.

26. (Once Amended) A semiconductor structure comprising:

a semiconductor substrate; and

an [ARC] antireflective coating upon said semiconductor substrate, [said ARC] the antireflective coating being composed of a metal silicon nitride ternary compound $M_xSi_yN_z$, wherein:

x is greater than zero;

y is greater than x;

z is greater than zero and less than about 5y;

M is at least two transition metals composed of $M1_rM2_{1-r}$;

r is in a range from 0 to 1;

M1 and M2 are selected from the group consisting of Sc, Ti, Zr, Nb, Ta, Mo, W, Co, and Ni; and

M1 is not M2.

27. (Once Amended) The semiconductor structure as defined in Claim 26, wherein [said ARC] the antireflective coating has a thickness range from about 25 Angstroms to about 1,000 Angstroms.

28. (Once Amended) The semiconductor structure as defined in Claim 26, wherein [said ARC] the antireflective coating is also composed of hemispherical grained polysilicon.

29. (Once Amended) A semiconductor structure comprising:

an electrically insulative layer upon a semiconductor substrate;

a patterned electrically conductive metal line upon the electrically insulative layer; and

an [ARC] antireflective coating upon said electrically conductive metal line, wherein the antireflective coating is configured to minimize reflectivity of deep ultraviolet light, [said ARC] the antireflective coating being composed of a metal silicon nitride ternary compound $M_xSi_yN_z$, wherein:

x is greater than zero[,];

M is at least one transition metal selected from the group consisting of Sc, Ti, Zr, Nb, Ta, Mo, W, Co, Al, and Ni;

y is greater than x; and

z is greater than about 0 and less than about 5y.

30. (Once Amended) The semiconductor structure as defined in Claim 29, wherein [said ARC] the antireflective coating has a thickness range from about 25 Angstroms to about 1,000 Angstroms.

31. (Once Amended) The semiconductor structure as defined in Claim 29, wherein [said ARC] the antireflective coating is also composed of hemispherical grained polysilicon.

32. (Once Amended) A semiconductor structure comprising:

a semiconductor substrate; and

an [ARC] antireflective coating over the semiconductor substrate, [said ARC] the antireflective coating being composed of a metal silicide binary compound, wherein the metal is at least one metal selected from the group consisting of Sc, Ti, Zr, Nb, Ta, Mo, W, Co, Al, and Ni.

36. (Once Amended) The semiconductor structure as defined in Claim 32, wherein:

the metal silicide binary compound is M_xSi_y; and

M is tungsten, x is 1, and Si is in a range from about 1.5 to about 5.

37. (Once Amended) The semiconductor structure as defined in Claim 32, wherein [said ARC] the antireflective coating is further composed of hemispherical grained polysilicon.

38. (Once Amended) The semiconductor structure as defined in Claim 32, wherein:

[said ARC] the antireflective coating has a film thickness and a grain size; and

the grain size of the [ARC] antireflective coating is less than the film thickness or is amorphous.

39. (Once Amended) The semiconductor structure as defined in Claim 32, wherein the [ARC] antireflective coating reflects incident light energy in a reflectivity that is in a range from 0 percent to about 30 percent.

40. (Once Amended) The semiconductor structure as defined in Claim 32, wherein:

the [ARC] antireflective coating is upon a formation that is selected from the group consisting of an isolation trench, a contact corridor, a via, a stacked storage node well, and a wiring trench.